The Health Benefits of SMOKING CESSATION

a report of the Surgeon General

1990

Executive Summary

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Centers for Disease Control
Center for Chronic Disease Prevention and Health Promotion
Office on Smoking and Health
Rockville, Maryland 20857

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THE SECRETARY OF HEALTH AND HUMAN SERVICES
WASHINGTON, D.C. 20201

SEP 13 1990

The Honorable Thomas S. Foley
Speaker of the House of
Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

It is my pleasure to transmit to the Congress the 1990 Surgeon General's Report on the health consequences of smoking as mandated by Section 8(a) of the Public Health Cigarette Smoking Act of 1969 (Pub. L. 91-222). The report was prepared by the Centers for Disease Control's Office on Smoking and Health.

This report, entitled The Health Benefits of Smoking Cessation, examines how an individual's risk of smoking-related diseases declines after quitting smoking. The evidence is overwhelming that smoking cessation has major and immediate health benefits for men and women of all ages. Smoking cessation increases overall life expectancy and reduces the risk of lung cancer, other cancers, heart attack, stroke, and chronic lung disease such as emphysema. The health benefits of smoking cessation far exceed any risks from the average 5-pound weight gain or any adverse psychological effects that may follow quitting.

Cigarette smoking is the most important preventable cause of death in our society. It is responsible for approximately 390,000 deaths each year in the United States, or more than one of every six deaths. We must do all we can to prevent young people from taking up this deadly addiction, and we must help smokers quit. Given the enormous benefits of smoking cessation, and the fact that good smoking cessation programs can achieve abstinence rates of 20 to 40 percent at one-year followup, these programs are likely to be extremely cost-effective compared with other preventive or curative services. Therefore, I would encourage health insurers to provide payment for smoking cessation treatments that are shown to be effective. At a minimum, the treatment of nicotine addiction should be considered as favorably by third-party payors as treatment of alcoholism and illicit drug addiction.

This report should help convince all smokers of the compelling need to quit smoking.

Sincerely,

Louis W. Sullivan

Louis W. Sullivan, M.D.
Secretary

Enclosure

THE SECRETARY OF HEALTH AND HUMAN SERVICES
WASHINGTON, D.C. 20201

SEP 13 1990

The Honorable Dan Quayle
President of the Senate
Washington, D.C. 20515

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Enclosure

FOREWORD

More than 38 million Americans have quit smoking cigarettes, and nearly half of all living adults who ever smoked have quit. Unfortunately, some 50 million Americans continue to smoke cigarettes, despite the many health education programs and anti-smoking campaigns that have been conducted during the past quarter century, despite the declining social acceptability of smoking, and despite the consequences of smoking to their health.

Twenty previous reports of the Surgeon General have reviewed the health effects of smoking. Scientific data are now available on the consequences of smoking cessation for most smoking-related diseases. Previous reports have considered some of these data, but this Report is the first to provide a comprehensive and unified review of this topic.

The major conclusions of this volume are:

1. **Smoking cessation has major and immediate health benefits for men and women of all ages. Benefits apply to persons with and without smoking-related disease.**
2. **Former smokers live longer than continuing smokers. For example, persons who quit smoking before age 50 have one-half the risk of dying in the next 15 years compared with continuing smokers.**
3. **Smoking cessation decreases the risk of lung cancer, other cancers, heart attack, stroke, and chronic lung disease.**
4. **Women who stop smoking before pregnancy or during the first 3 to 4 months of pregnancy reduce their risk of having a low birthweight baby to that of women who never smoked.**
5. **The health benefits of smoking cessation far exceed any risks from the average 5-pound (2.3-kg) weight gain or any adverse psychological effects that may follow quitting.**

With the long-standing evidence that smoking is extremely harmful to health and the mounting evidence that smoking cessation confers major health benefits, we remain faced with the task of developing effective strategies to curtail the use of tobacco. Two broad categories of intervention are available: prevention of smoking initiation among youth and smoking cessation. Resources for tobacco control are limited, and policymakers must decide how best to allocate those resources to smoking prevention and cessation.

The goal of public health is to intervene as early as possible to prevent disease, disability, and premature death. From that standpoint, prevention of smoking initiation

should be a major priority. More than 3,000 teenagers become regular smokers *each day* in the United States. Because of the strength of nicotine addiction, some have argued that public health efforts should focus on smoking prevention rather than smoking cessation. However, this need not be an "either-or" situation.

Public health practitioners have categorized interventions into primary, secondary, and tertiary prevention. Primary prevention generally refers to the elimination of risk factors for disease in asymptomatic persons. Secondary prevention is defined as the early detection and treatment of disease, and is practiced using tools such as Pap smears and blood pressure screening. Tertiary prevention consists of measures to reduce impairment, disability, and suffering in people with existing disease.

Smoking cessation falls under the category of primary prevention as does the prevention of smoking initiation. Smoking cessation meets the definition of primary prevention by reducing the risk of morbidity and premature mortality in asymptomatic people. In addition, parents who quit smoking reduce or eliminate the risk of passive-smoking-related disease among their children and reduce the probability that their children will become smokers. Thus, there should be no debate about the need for smoking prevention versus cessation—both are important.

Public awareness of the health effects of smoking has increased substantially through the years. Nevertheless, important gaps in public knowledge still exist. Some smokers may have failed to quit because of a lack of appreciation of the health hazards of smoking and the benefits of quitting. In the 1987 National Health Interview Survey of Cancer Epidemiology and Control, respondents were asked whether smoking increases the risk of various diseases (lung cancer, cancer of the mouth and throat, heart disease, emphysema, and chronic bronchitis) and whether smoking cessation reduces the risk. Thirty to forty percent of smokers either did not believe that smoking increases these risks or did not believe that cessation reduces these risks. These proportions correspond to 15 to 20 million smokers in the United States. Clearly, our efforts to educate the public on the health hazards of smoking and the benefits of quitting are not yet complete.

As we continue and intensify our efforts to inform the public of these findings, we must make available smoking cessation programs and services to those who need them. Although 90 percent of former smokers quit without using smoking cessation programs, counseling, or nicotine gum, smokers who do need this assistance should have it available. We endorse the view expressed in the Preface to the 1988 Surgeon General's Report that treatment of nicotine addiction should be considered at least as favorably by third-party payors as treatment of alcoholism and illicit drug addiction. Good smoking cessation treatments can achieve abstinence rates of 20 to 40 percent at 1-year followup. Those success rates, combined with the enormous health benefits of smoking cessation, would likely make payment for some smoking cessation treatments cost-beneficial. For example, research by the Centers for Disease Control suggests that a smoking cessation program offered to all pregnant smokers could save $5 for every dollar spent by preventing low birthweight-associated neonatal intensive care and long-term care.

This Report should galvanize the health community to stress repeatedly at every opportunity the value of smoking cessation to the 50 million Americans who continue to smoke.

James O. Mason, M.D., Dr.P.H.
Assistant Secretary for Health
Public Health Service

William L. Roper, M.D.
Director
Centers for Disease Control

PREFACE

This Report of the Surgeon General is the 21st Report of the U.S. Public Health Service on the health consequences of smoking and the first issued during my tenure as Surgeon General. Whereas previous reports have focused on the health effects of smoking, this Report is devoted to the benefits of smoking cessation.

The public health impact of smoking is enormous. As documented in the 1989 Surgeon General's Report, an estimated 390,000 Americans die each year from diseases caused by smoking. This toll includes 115,000 deaths from heart disease; 106,000 from lung cancer; 31,600 from other cancers; 57,000 from chronic obstructive pulmonary disease; 27,500 from stroke; and 52,900 from other conditions related to smoking. More than one of every six deaths in the United States are caused by smoking. For more than a decade the Public Health Service has identified cigarette smoking as the most important preventable cause of death in our society.

It is clear, then, that the elimination of smoking would yield substantial benefits for public health. What are the benefits, however, for the individual smoker who quits? A large body of evidence has accumulated to address that question and derives from cohort and case–control studies, cross-sectional surveys, and clinical trials. In studies of the health effects of smoking cessation, persons classified as former smokers may include some current smokers; this misclassification is likely to cause an underestimation of the health benefits of quitting. Taken together, the evidence clearly indicates that smoking cessation has major and immediate health benefits for men and women of all ages.

Overall Benefits of Smoking Cessation

People who quit smoking live longer than those who continue to smoke. To what extent is a smoker's risk of premature death reduced after quitting smoking? The answer depends on several factors, including the number of years of smoking, the number of cigarettes smoked per day, and the presence or absence of disease at the time of quitting. Data from the American Cancer Society's Cancer Prevention Study II (CPS-II) were analyzed in this Report to estimate the risk of premature death in ex-smokers versus current smokers. These data show, for example, that persons who quit smoking before age 50 have one-half the risk of dying in the next 15 years compared with continuing smokers.

Smoking cessation increases life expectancy because it reduces the risk of dying from specific smoking-related diseases. One such disease is lung cancer, the most common cause of cancer death in both men and women. The risk of dying from lung cancer is

22 times higher among male smokers and 12 times higher among female smokers compared with people who have never smoked.The risk of lung cancer declines steadily in people who quit smoking; after 10 years of abstinence, the risk of lung cancer is about 30 to 50 percent of the risk for continuing smokers. Smoking cessation also reduces the risk of cancers of the larynx, oral cavity, esophagus, pancreas, and urinary bladder.

Coronary heart disease (CHD) is the leading cause of death in the United States. Smokers have about twice the risk of dying from CHD compared with lifetime nonsmokers. This excess risk is reduced by about half among ex-smokers after only 1 year of smoking abstinence and declines gradually thereafter. After 15 years of abstinence the risk of CHD is similar to that of persons who have never smoked.

Compared with lifetime nonsmokers, smokers have about twice the risk of dying from stroke, the third leading cause of death in the United States. After quitting smoking, the risk of stroke returns to the level of people who have never smoked; in some studies this reduction in risk has occurred within 5 years, but in others as long as 15 years of abstinence were required.

Cigarette smoking is the major cause of chronic obstructive pulmonary disease (COPD), the fifth leading cause of death in the United States. Smoking increases the risk of COPD by accelerating the age-related decline in lung function. With sustained abstinence from smoking, the rate of decline in lung function among former smokers returns to that of never smokers, thus reducing the risk of developing COPD.

Influenza and pneumonia represent the sixth leading cause of death in the United States. Cigarette smoking increases the risk of respiratory infections such as influenza, pneumonia, and bronchitis, and smoking cessation reduces the risk.

Cigarette smoking is a major cause of peripheral artery occlusive disease. This condition causes substantial mortality and morbidity; complications may include intermittent claudication, tissue ischemia and gangrene, and ultimately, loss of limb. Smoking cessation substantially reduces the risk of peripheral artery occlusive disease compared with continued smoking.

The mortality rate from abdominal aortic aneurysm is two to five times higher in current smokers than in never smokers. Former smokers have half the excess risk of dying from this condition relative to current smokers.

About 20 million Americans currently have, or have had, an ulcer of the stomach or duodenum. Smokers have an increased risk of developing gastric or duodenal ulcers, and this increased risk is reduced by quitting smoking.

Benefits at All Ages

According to a 1989 Gallup survey, the proportion of smokers who say they would like to give up smoking is lower for smokers aged 50 and older (57 percent) than for smokers aged 18–29 (68 percent) and 30–49 (67 percent). Older smokers may be less motivated to quit smoking because the highly motivated may have quit already at younger ages, leaving a relatively "hard-core" group of older smokers. But many long-term smokers may lack motivation to quit for other reasons. Some may believe they are no longer at risk of smoking-related diseases because they have already survived smoking for many years. Others may believe that any damage that may have

been caused by smoking is irreversible after decades of smoking. For similar reasons, many physicians may be less likely to counsel their older patients to quit.

CPS-II data were used to estimate the effects of quitting smoking at various ages on the cumulative risk of death during a fixed interval after cessation. The results show that the benefits of cessation extend to quitting at older ages. For example, a healthy man aged 60–64 who smokes 1 pack of cigarettes or more per day reduces his risk of dying during the next 15 years by 10 percent if he quits smoking.

These findings support the recommendations of the Surgeon General's 1988 Workshop on Health Promotion and Aging for the development and dissemination of smoking cessation messages and interventions to older persons. I am pleased that a coalition of organizations and agencies is now working toward implementation of those recommendations, including the Centers for Disease Control; the National Cancer Institute; the National Heart, Lung, and Blood Institute; the Administration on Aging; the Department of Veterans Affairs; the Office of Disease Prevention and Health Promotion; the American Association of Retired Persons; and the Fox Chase Cancer Center. The major message of this campaign will be that it is never too late to quit smoking.

Two facts point to the urgent need for a strong smoking cessation campaign targeting older Americans: (1) 7 million smokers are aged 60 or older; and (2) smoking is a major risk factor for 6 of the 14 leading causes of death among those aged 60 and older, and is a complicating factor for 3 others.

Benefits for Smokers with Existing Disease

Many smokers who have already developed smoking-related disease or symptoms may be less motivated to quit because of a belief that the damage is already done. For the same reason, physicians may be less motivated to advise these patients to quit. However, the evidence reviewed in this Report shows that smoking cessation yields important health benefits to those who already suffer from smoking-related illness.

Among persons with diagnosed CHD, smoking cessation markedly reduces the risk of recurrent heart attack and cardiovascular death. In many studies, this reduction in risk has been 50 percent or more. Smoking cessation is the most important intervention in the management of peripheral artery occlusive disease; for patients with this condition, quitting smoking improves exercise tolerance, reduces the risk of amputation after peripheral artery surgery, and increases overall survival. Patients with gastric and duodenal ulcers who stop smoking improve their clinical course relative to smokers who continue to smoke. Although the benefits of smoking cessation among stroke patients have not been studied, it is reasonable to assume that quitting smoking reduces the risk of recurrent stroke just as it reduces the risk of recurrence of other cardiovascular events.

Even smokers who have already developed cancer may benefit from smoking cessation. A few studies have shown that persons who stopped smoking after diagnosis of cancer had a reduced risk of acquiring a second primary cancer compared with persons who continued to smoke. Although relevant data are sparse, longer survival might be expected among smokers with cancer or other serious illnesses if they stop

smoking. Smoking cessation reduces the risk of respiratory infections such as pneumonia, which are often the immediate causes of death in patients with an underlying chronic disease.

The important role of health care providers in counseling patients to quit smoking is well recognized. Health care providers should give smoking cessation advice and assistance to all patients who smoke, including those with existing illness.

Benefits for the Fetus

Maternal smoking is associated with several complications of pregnancy including abruptio placentae, placenta previa, bleeding during pregnancy, premature and prolonged rupture of the membranes, and preterm delivery. Maternal smoking retards fetal growth, causes an average reduction in birthweight of 200 g, and doubles the risk of having a low birthweight baby. Studies have shown a 25- to 50-percent higher rate of fetal and infant deaths among women who smoke during pregnancy compared with those who do not.

Women who stop smoking before becoming pregnant have infants of the same birthweight as those born to women who have never smoked. The same benefit accrues to women who quit smoking in the first 3 to 4 months of pregnancy and who remain abstinent throughout the remainder of pregnancy. Women who quit smoking at later stages of pregnancy, up to the 30th week of gestation, have infants with higher birthweight than do women who smoke throughout pregnancy.

Smoking is probably the most important modifiable cause of poor pregnancy outcome among women in the United States. Recent estimates suggest that the elimination of smoking during pregnancy could prevent about 5 percent of perinatal deaths, about 20 percent of low birthweight births, and about 8 percent of preterm deliveries in the United States. In groups with a high prevalence of smoking (e.g., women who have not completed high school), the elimination of smoking during pregnancy could prevent about 10 percent of perinatal deaths, about 35 percent of low birthweight births, and about 15 percent of preterm deliveries.

The prevalence of smoking during pregnancy has declined over time but remains unacceptably high. Approximately 30 percent of U.S. women who are cigarette smokers quit after recognition of pregnancy, and others quit later in pregnancy. However, about 25 percent of pregnant women in the United States smoke throughout pregnancy. A shocking statistic is that half of pregnant women who have not completed high school smoke throughout pregnancy. Many women who do not quit smoking during pregnancy reduce their daily cigarette consumption; however, reduced consumption without quitting may have little or no benefit for birthweight. Of the women who quit smoking during pregnancy, 70 percent resume smoking within 1 year of delivery.

Initiatives have been launched in the public and private sectors to reduce smoking during pregnancy. These programs should be expanded, and less educated pregnant women should be a special target of these efforts. Strategies need to be developed to address the problem of relapse after delivery.

Benefits for Infants and Children

As a pediatrician, I am particularly concerned about the effects of parental smoking on infants and children. Evidence reviewed in the 1986 Surgeon General's Report, *The Health Consequences of Involuntary Smoking*, indicates that the children of parents who smoke, compared with the children of nonsmoking parents, have an increased frequency of respiratory infections such as pneumonia and bronchitis. Many studies have found a dose–response relationship between respiratory illness in children and their level of tobacco smoke exposure.

Several studies have shown that children exposed to tobacco smoke in the home are more likely to develop acute otitis media and persistent middle ear effusions. Middle ear disease imposes a substantial burden on the health care system. Otitis media is the most frequent diagnosis made by physicians who care for children. The myringotomy-and-tube procedure, used to treat otitis media in more than 1 million American children each year, is the most common minor surgical operation performed under general anesthesia.

The impact of smoking cessation during or after pregnancy on these associations has not been studied. However, the dose–response relationship between parental smoking and frequency of childhood respiratory infections suggests that smoking cessation during pregnancy and abstinence after delivery would eliminate most or all of the excess risk by eliminating most or all of the exposure.

If parents are unwilling to quit smoking for their own sake, I would urge them to quit for the sake of their children. Passive-smoking-induced infections in infants and young children can cause serious and even fatal illness. Moreover, children whose parents smoke are much more likely to become smokers themselves.

Smoking Cessation and Weight Gain

The fear of postcessation weight gain may discourage many smokers from trying to quit. The fear or occurrence of weight gain may precipitate relapse among many of those who already have quit. In the 1986 Adult Use of Tobacco Survey, current smokers who had tried to quit were asked to judge the importance of several possible reasons for their return to smoking. Twenty-seven percent reported that "actual weight gain" was a "very important" or "somewhat important" reason why they resumed smoking; 22 percent said that "the possibility of gaining weight" was an important reason for their relapse. Forty-seven percent of current smokers and 48 percent of former smokers agreed with the statement that "smoking helps control weight."

Fifteen studies involving a total of 20,000 persons were reviewed in this Report to determine the likelihood of gaining weight and the average weight gain after quitting. Although four-fifths of smokers who quit gained weight after cessation, the average weight gain was only 5 pounds (2.3 kg). The average weight gain among subjects who continued to smoke was 1 pound. Thus, smoking cessation produces a 4-pound greater weight gain than that associated with continued smoking. This weight gain poses a minimal health risk. Moreover, evidence suggests that this small weight gain is accompanied by favorable changes in lipid profiles and in body fat distribution.

Smoking cessation programs and messages should emphasize that weight gain after quitting is small on average.

Not only is the average postcessation weight gain small, but the risk of large weight gain after quitting is extremely low. Less than 4 percent of those who quit smoking gain more than 20 pounds. Nevertheless, special advice and assistance should be available to the rare person who does gain considerable weight after quitting. For these individuals, the health benefits of cessation still occur, and weight control programs rather than smoking relapse should be implemented.

Increases in food intake and decreases in resting energy expenditure are largely responsible for postcessation weight gain. Thus, dietary advice and exercise should be helpful in preventing or reducing postcessation weight gain. Unfortunately, minor weight control modifications to smoking cessation programs do not generally yield beneficial effects in terms of reducing weight gain or increasing cessation rates. A few studies have investigated pharmacologic approaches to postcessation weight control; preliminary results are encouraging but more research is needed. High priority should be given to the development and evaluation of effective weight control programs that can be targeted in a cost-effective manner to those at greatest need of assistance.

Psychological and Behavioral Consequences of Smoking Cessation

Nicotine withdrawal symptoms include anxiety, irritability, frustration, anger, difficulty concentrating, increased appetite, and urges to smoke. With the possible exception of urges to smoke and increased appetite, these effects soon disappear. Nicotine withdrawal peaks in the first 1 to 2 days following cessation and subsides rapidly during the following weeks. With long-term abstinence, former smokers are likely to enjoy favorable psychological changes such as enhanced self-esteem and increased sense of self-control.

Although most nicotine withdrawal symptoms are short-lived, they often exert a strong influence on smokers' ability to quit and maintain abstinence. Nicotine withdrawal may discourage many smokers from trying to quit and may precipitate relapse among those who have recently quit. In the 1986 Adult Use of Tobacco Survey, 39 percent of current smokers reported that irritability was a "very important" or "somewhat important" reason why they resumed smoking after a previous quit attempt.

Smokers and ex-smokers should be counseled that adverse psychological effects of smoking subside rapidly over time. Smoking cessation materials and programs, nicotine replacement, exercise, stress management, and dietary counseling can help smokers cope with these symptoms until they abate, after which favorable psychological changes are likely to occur.

Support for a Causal Association Between Smoking and Disease

Tens of thousands of studies have documented the associations between cigarette smoking and a large number of serious diseases. It is safe to say that smoking represents the most extensively documented cause of disease ever investigated in the history of biomedical research.

Previous Surgeon General's reports, in particular the landmark 1964 Report of the Surgeon General's Advisory Committee on Smoking and Health and the 1982 Surgeon General's Report on smoking and cancer, examined these associations with respect to the epidemiologic criteria for causality. These criteria include the consistency, strength, specificity, coherence, and temporal relationship of the association. Based on these criteria, previous reports have recognized a causal association between smoking and cancers of the lung, larynx, esophagus, and oral cavity; heart disease; stroke; peripheral artery occlusive disease; chronic obstructive pulmonary disease; and intrauterine growth retardation. This Surgeon General's Report is the first to conclude that the evidence is now sufficient to identify cigarette smoking as a cause of cancer of the urinary bladder; the 1982 Report concluded that cigarette smoking is a contributing factor in the development of bladder cancer.

The causal nature of most of these associations was well established long before publication of this Report. Nevertheless, it is worth noting that the findings of this Report add even more weight to the evidence that these associations are causal. The criterion of coherence requires that descriptive epidemiologic findings on disease occurrence correlate with measures of exposure to the suspected agent. Coherence would predict that the increased risk of disease associated with an exposure would diminish or disappear after cessation of exposure. As this Report shows in great detail, the risks of most smoking-related diseases decrease after cessation and with increasing duration of abstinence.

Evidence on the risk of disease after smoking cessation is especially important for the understanding of smoking-and-disease associations of unclear causality. For example, cigarette smoking is associated with cancer of the uterine cervix, but this association is potentially confounded by unidentified factors (in particular by a sexually transmitted etiologic agent). The evidence reviewed in this Report indicates that former smokers experience a lower risk of cervical cancer than current smokers, even after adjusting for the social correlates of smoking and risk of sexually acquired infections. This diminution of risk after smoking cessation supports the hypothesis that smoking is a contributing cause of cervical cancer.

Conclusion

The Comprehensive Smoking Education Act of 1984 (Public Law 98–474) requires the rotation of four health warnings on cigarette packages and advertisements. One of those warnings reads, "SURGEON GENERAL'S WARNING: Quitting Smoking Now Greatly Reduces Serious Risks to Your Health." The evidence reviewed in this Report confirms and expands that advice.

The health benefits of quitting smoking are immediate and substantial. They far exceed any risks from the average 5-pound weight gain or any adverse psychological effects that may follow quitting. The benefits extend to men and women, to the young and the old, to those who are sick and to those who are well. Smoking cessation represents the single most important step that smokers can take to enhance the length and quality of their lives.

Public opinion polls tell us that most smokers want to quit. This Report provides smokers with new and more powerful motivation to give up this self-destructive behavior.

Antonia C. Novello, M.D., M.P.H.
Surgeon General

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The scientific editors of the Report were:

Jonathan M. Samet, M.D. (Senior Scientific Editor), Professor of Medicine and Chief, Pulmonary Division, Department of Medicine and the New Mexico Tumor Registry, Cancer Center, University of New Mexico, Albuquerque, New Mexico

Ronald M. Davis, M.D., Director, Office on Smoking and Health, Center for Chronic Disease Prevention and Health Promotion (CCDPHP), Centers for Disease Control (CDC), Rockville, Maryland

Neil E. Grunberg, Ph.D., Professor, Department of Medical Psychology, Uniformed Services University of the Health Sciences, Bethesda, Maryland

Judith K. Ockene, Ph.D., Professor of Medicine, and Director, Division of Preventive and Behavioral Medicine, Department of Medicine, University of Massachusetts Medical School, Worcester, Massachusetts

Diana B. Petitti, M.D., M.P.H., Associate Professor, Department of Family and Community Medicine, University of California at San Francisco, School of Medicine, San Francisco, California

Walter C. Willett, M.D., Dr.P.H., Professor of Epidemiology and Nutrition, Harvard School of Public Health, and The Channing Laboratory, Department of Medicine, Harvard Medical School and Brigham and Women's Hospital, Boston, Massachusetts

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Appendix

CHAPTER 1
INTRODUCTION, OVERVIEW, AND CONCLUSIONS

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INTRODUCTION

The 1964 Report of the Surgeon General's Advisory Committee on Smoking and Health (US PHS 1964) concluded that cigarette smoking is a cause of lung cancer and laryngeal cancer in men, a probable cause of lung cancer in women, and the most important cause of chronic bronchitis. Other diseases, including emphysema and cardiovascular disease, also were found to be associated with cigarette smoking, although the evidence available at that time was not viewed as sufficient to establish the associations as causal. Even in 1964, however, the evidence for adverse health consequences of cigarette smoking was sufficient for the Committee to conclude that "cigarette smoking is a health hazard of sufficient importance in the United States to warrant appropriate remedial action" (US PHS 1964, p. 33).

Subsequent reports of the Surgeon General on smoking and health expanded and strengthened the conclusions of the 1964 Report on active smoking and documented the benefits of smoking cessation. (See US DHHS 1989 for review.) For some diseases, such as cardiovascular disease, newer evidence warranted a determination that associations with cigarette smoking were causal. Further associations of cigarette smoking with disease were identified, and involuntary (passive) smoking was found to be a cause of disease in nonsmokers (US DHHS 1986). Although cigarette smoking has been investigated intensively since the 1950s, new associations of smoking with adverse effects continue to be identified. For example, in a recent study smoking was associated with cataracts (West et al. 1989).

Evidence substantiates cigarette smoking as a cause of disease in smokers and, through involuntary smoking, in never smokers as well. This evidence has motivated the implementation of diverse and far-reaching programs for smoking prevention and cessation. The proportion of U.S. adults who smoke decreased substantially since the 1964 Report. In 1965, 29.6 percent of persons who had ever smoked had quit; by 1987, this percentage had increased to 44.8, representing more than 38 million adults. As the numbers of formerly smoking adults increased in the United States and other countries (US DHHS 1989), epidemiologic and clinical studies provided increasingly extensive information on the health benefits of smoking cessation. Thus, the 1964 Report noted that former smokers had lower overall mortality rates and lower lung cancer risk than current smokers, but the cited evidence was limited. Scientific data are now available on the consequences of cessation for most smoking-related diseases. Major benefits have been shown for overall mortality and for many specific diseases. Although past reports have considered much of the evidence, these data have not received a comprehensive and unified review. This Report systematically reviews the findings on the health benefits and consequences of cessation.

This Report includes a Foreword by the Assistant Secretary for Health and the Director of the Centers for Disease Control, a Preface by the Surgeon General of the U.S. Public Health Service, and the following chapters:

Chapter 1. Introduction, Overview, and Conclusions

Chapter 2. Assessing Smoking Cessation and Its Health Consequences

Chapter 3. Smoking Cessation and Overall Mortality and Morbidity

Chapter 4. Smoking Cessation and Respiratory Cancers

Chapter 5. Smoking Cessation and Nonrespiratory Cancers

Chapter 6. Smoking Cessation and Cardiovascular Disease

Chapter 7. Smoking Cessation and Nonmalignant Respiratory Diseases

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Chapter 11. Psychological and Behavioral Consequences and Correlates of Smoking Cessation

Volume Appendix. National Trends in Smoking Cessation

A key to acronyms and terms used throughout the Report is found at the end of the volume.

Other publications of the Public Health Service have reviewed determinants of smoking cessation and abstinence (US DHEW 1979; US DHHS 1980, 1988) and methods of smoking cessation and relapse prevention (Schwartz 1987; US DHHS 1988); hence, these topics are not covered in this Report.

Beginning with the 1964 Report, the evidence on active smoking and disease has been reviewed for causality to evaluate the associations of smoking with disease. The explicit criteria used in this evaluation include the consistency, strength, specificity, temporal relationship, and coherence of the association (US PHS 1964; US DHHS 1989). These criteria have provided a consistent and effective framework for examining the epidemiologic, clinical, and experimental data on active smoking. Although the criteria cannot be applied in the same fashion to associations of smoking cessation with changes in disease occurrence, the criteria of consistency, an appropriate temporal relationship, and coherence must be maintained with evidence on smoking cessation and health.

Thus, this Report examines data for consistency among investigations of the associations of cessation with disease occurrence and other outcomes, and considers the biologic plausibility of the known or presumed associations in the context of the mechanisms by which cigarette smoking is known or thought to cause disease. The appropriate time sequence of cessation with its effect is evident; cessation must always precede its presumed effect. In an observational study, this sequence may be reversed by the tendency of persons with initial symptoms of a cigarette-related disease or with frank disease to reduce cigarette consumption or to stop smoking (Chapter 2). The findings of longitudinal studies among former smokers document high mortality rates among short-term former smokers, which is consistent with reversal of the causal

sequence of cessation followed by reduced disease occurrence; that is, disease has caused a change in exposure (Rogot and Murray 1980).

Cigarette smoke in its gaseous and particulate phases contains thousands of agents, many of which can damage tissues and cause disease (US DHEW 1979; US DHHS 1986, 1989). The pathogenetic mechanisms by which cigarette smoking causes disease are diverse, ranging from longer term processes, such as carcinogenesis, to shorter term processes, such as interference with tissue oxygenation by carbon monoxide. Thus, the biologic context in which the evidence on cessation is considered must be disease-specific; a unified biologic framework for evaluating the evidence on cessation cannot be offered.

For example, cigarette smoking causes emphysema, an irreversible destruction of the gas-exchanging structure of the lung, and permanent or only partially reversible damage to the airways of the lung. Little improvement of lung function after cessation would be anticipated for a long-term smoker with disabling chronic obstructive pulmonary disease (COPD) and extensive irreversible damage to the lung. However, cessation would benefit a smoker who has less extensive damage by slowing the rate of lung function decline and thereby reducing the likelihood of clinically significant impairment. By contrast with COPD, smoking cessation following myocardial infarction has both relatively immediate and longer term benefits. The immediately decreased risk of death in those who stop smoking in comparison with those who continue to smoke may reflect a decrease of blood coagulability, improved tissue oxygenation, and less predisposition to cardiac arrhythmias after cessation.

The findings of studies on the health consequences of smoking cessation also provide evidence relevant to determining the causality of associations of active smoking with disease. A decline in disease incidence after cessation needs to be considered as a positive indication of such a causal association. However, the pattern of changing risk after cessation must be interpreted in the context of the mechanism of disease causation by active smoking.

In interpreting individual studies on the consequences of smoking cessation, difficult methodologic and conceptual issues must be considered. Chapter 2 addresses these issues in depth. Because smoking cessation is a dynamic process, often involving multiple relapses to active smoking, accurate characterization of the former smoker is difficult and best accomplished by longitudinal observation. Misclassification of cigarette smoking status may lead to biased estimates of the consequences of smoking cessation. In observational studies and trials some subjects may report that they are former smokers, even though they continue to smoke; the resulting misclassification tends to result in underestimation of the benefits of cessation. Unraveling the consequences of smoking cessation from the effects of other factors determining the occurrence of disease poses a substantial analytical challenge. In reviewing individual reports on the consequences of smoking cessation, the approaches to these potential methodologic issues were assessed (Chapter 2).

MAJOR CONCLUSIONS

More than 38 million Americans have quit smoking, and almost half of all living adults in the United States who ever smoked have quit (Volume Appendix). Nevertheless, more than 50 million Americans continue to smoke. This Report reviews in detail the health consequences of smoking cessation for those who have quit and for those who will quit in the future. The following major volume conclusions summarize the health consequences of smoking cessation for those who quit smoking in comparison with those who continue to smoke:

1. **Smoking cessation has major and immediate health benefits for men and women of all ages. Benefits apply to persons with and without smoking-related disease.**

2. **Former smokers live longer than continuing smokers. For example, persons who quit smoking before age 50 have one-half the risk of dying in the next 15 years compared with continuing smokers.**

3. **Smoking cessation decreases the risk of lung cancer, other cancers, heart attack, stroke, and chronic lung disease.**

4. **Women who stop smoking before pregnancy or during the first 3 to 4 months of pregnancy reduce their risk of having a low birthweight baby to that of women who never smoked.**

5. **The health benefits of smoking cessation far exceed any risks from the average 5-pound (2.3-kg) weight gain or any adverse psychological effects that may follow quitting.**

DEVELOPMENT OF THE REPORT

This Report was developed by the Office on Smoking and Health (OSH), Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control, Public Health Service of the U.S. Department of Health and Human Services, as part of the Department's responsibility under Public Law 91–222 to report new and current information on smoking and health to the U.S. Congress.

The scientific content of this Report was produced through the efforts of more than 120 scientists in the fields of medicine, psychology, the biologic and social sciences, and public health. Manuscripts for the Report, constituting drafts of chapters or sections of chapters, were prepared by 26 scientists selected for their expertise in specific content areas. An editorial team, including the Director of OSH, a medical psychologist with the Uniformed Services University of the Health Sciences, and four non-Federal experts, edited and consolidated the individual manuscripts into chapters. These draft chapters were subjected to an intensive outside peer review, with each chapter reviewed by an average of five individuals knowledgeable about the chapter's subject matter. Incorporating the reviewers' comments, the editors revised the chapters and assembled a draft of the complete Report. The draft Report was then submitted to 25 distinguished

scientists for their review and comment on the entirety of its contents. Simultaneously, the draft Report was submitted to 10 institutes and agencies within the U.S. Public Health Service for review. Comments from the senior scientific reviewers and the agencies were then used to prepare the final draft of the Report, which was then reviewed by the Office of the Assistant Secretary for Health and the Secretary, Department of Health and Human Services.

CHAPTER CONCLUSIONS

Chapter 2: Assessing Smoking Cessation and Its Health Consequences

1. Most former smokers have cycled several times through the process of smoking cessation and relapse before attaining long-term abstinence. Any static measure of smoking status is thus a simplification of a dynamic process.

2. In studies of the health effects of smoking cessation, persons classified as former smokers may include some current smokers. Consequently, the health benefits of smoking cessation are likely to be underestimated.

3. In contexts other than intervention trials, self-reported smoking status at the time of measurement and concurrent biochemical assessment are highly concordant. This high concordance supports self-report as a valid measure of smoking status in observational studies of the health effects of smoking cessation.

Chapter 3: Smoking Cessation and Overall Mortality and Morbidity

1. Former smokers live longer than continuing smokers, and the benefits of quitting extend to those who quit at older ages. For example, persons who quit smoking before age 50 have one-half the risk of dying in the next 15 years compared with continuing smokers.

2. Smoking cessation at all ages reduces the risk of premature death.

3. Among former smokers, the decline in risk of death compared with continuing smokers begins shortly after quitting and continues for at least 10 to 15 years. After 10 to 15 years of abstinence, risk of all-cause mortality returns nearly to that of persons who never smoked.

4. Former smokers have better health status than current smokers as measured in a variety of ways, including days of illness, number of health complaints, and self-reported health status.

Chapter 4: Smoking Cessation and Respiratory Cancers

1. Smoking cessation reduces the risk of lung cancer compared with continued smoking. For example, after 10 years of abstinence, the risk of lung cancer is about 30 to 50 percent of the risk in continuing smokers; with further abstinence, the risk continues to decline.

2. The reduced risk of lung cancer among former smokers is observed in males and females, in smokers of filter and nonfilter cigarettes, and for all histologic types of lung cancer.

3. Smoking cessation lowers the risk of laryngeal cancer compared with continued smoking.

4. Smoking cessation reduces the severity and extent of premalignant histologic changes in the epithelium of the larynx and lung.

Chapter 5: Smoking Cessation and Nonrespiratory Cancers

1. Smoking cessation halves the risks for cancers of the oral cavity and esophagus, compared with continued smoking, as soon as 5 years after cessation, with further reduction over a longer period of abstinence.

2. Smoking cessation reduces the risk of pancreatic cancer, compared with continued smoking, although this reduction in risk may only be measurable after 10 years of abstinence.

3. Smoking is a cause of bladder cancer; cessation reduces risk by about 50 percent after only a few years, in comparison with continued smoking.

4. The risk of cervical cancer is substantially lower among former smokers in comparison with continuing smokers, even in the first few years after cessation. This finding supports the hypothesis that cigarette smoking is a contributing cause of cervical cancer.

5. Neither smoking nor smoking cessation are associated with the risk of cancer of the breast.

Chapter 6: Smoking Cessation and Cardiovascular Disease

1. Compared with continued smoking, smoking cessation substantially reduces risk of coronary heart disease (CHD) among men and women of all ages.

2. The excess risk of CHD caused by smoking is reduced by about half after 1 year of smoking abstinence and then declines gradually. After 15 years of abstinence, the risk of CHD is similar to that of persons who have never smoked.

3. Among persons with diagnosed CHD, smoking cessation markedly reduces the risk of recurrent infarction and cardiovascular death. In many studies, this reduction in risk of recurrence or premature death has been 50 percent or more.

4. Smoking cessation substantially reduces the risk of peripheral artery occlusive disease compared with continued smoking.

5. Among patients with peripheral artery disease, smoking cessation improves exercise tolerance, reduces the risk of amputation after peripheral artery surgery, and increases overall survival.

6. Smoking cessation reduces the risk of both ischemic stroke and subarachnoid hemorrhage compared with continued smoking. After smoking cessation, the risk of stroke returns to the level of never smokers; in some studies this has occurred within 5 years, but in others as long as 15 years of abstinence were required.

Chapter 7: Smoking Cessation and Nonmalignant Respiratory Diseases

1. Smoking cessation reduces rates of respiratory symptoms such as cough, sputum production, and wheezing, and respiratory infections such as bronchitis and pneumonia, compared with continued smoking.

2. For persons without overt chronic obstructive pulmonary disease (COPD), smoking cessation improves pulmonary function about 5 percent within a few months after cessation.

3. Cigarette smoking accelerates the age-related decline in lung function that occurs among never smokers. With sustained abstinence from smoking, the rate of decline in pulmonary function among former smokers returns to that of never smokers.

4. With sustained abstinence, the COPD mortality rates among former smokers decline in comparison with continuing smokers.

Chapter 8: Smoking Cessation and Reproduction

1. Women who stop smoking before becoming pregnant have infants of the same birthweight as those born to never smokers.

2. Pregnant smokers who stop smoking at any time up to the 30th week of gestation have infants with higher birthweight than do women who smoke throughout pregnancy. Quitting in the first 3 to 4 months of pregnancy and abstaining

throughout the remainder of pregnancy protect the fetus from the adverse effects of smoking on birthweight.

3. Evidence from two intervention trials suggests that reducing daily cigarette consumption without quitting has little or no benefit for birthweight.

4. Recent estimates of the prevalence of smoking during pregnancy, combined with an estimate of the relative risk of low birthweight outcome in smokers, suggest that 17 to 26 percent of low birthweight births could be prevented by eliminating smoking during pregnancy; in groups with a high prevalence of smoking (e.g., women with less than a high school education), 29 to 42 percent of low birthweight births might be prevented by elimination of cigarette smoking during pregnancy.

5. Approximately 30 percent of women who are cigarette smokers quit after recognition of pregnancy, with greater proportions quitting among married women and especially among women with higher levels of educational attainment.

6. Smoking causes women to have natural menopause 1 to 2 years early. Former smokers have an age at natural menopause similar to that of never smokers.

Chapter 9: Smoking, Smoking Cessation, and Other Nonmalignant Diseases

1. Smokers have an increased risk of development of both duodenal and gastric ulcer, and this increased risk is reduced by smoking cessation.

2. Ulcer disease is more severe among smokers than among nonsmokers. Smokers are less likely to experience healing of duodenal ulcers and are more likely to have recurrences of both duodenal and gastric ulcers within specified timeframes. Most ulcer medications fail to alter these tendencies.

3. Smokers with gastric or duodenal ulcers who stop smoking improve their clinical course relative to smokers who continue to smoke.

4. The evidence that smoking increases the risk of osteoporotic fractures or decreases bone mass is inconclusive, with many conflicting findings. Data on smoking cessation are extremely limited at present.

5. There is evidence that smoking is associated with prominent facial skin wrinkling in whites, particularly in the periorbital ("crow's foot") and perioral areas of the face. The effect of cessation on skin wrinkling is unstudied.

Chapter 10: Smoking Cessation and Body Weight Change

1. Average weight gain after smoking cessation is only about 5 pounds (2.3 kg). This weight gain poses a minimal health risk.

2. Approximately 80 percent of smokers who quit gain weight after cessation, but only about 3.5 percent of those who quit smoking gain more than 20 pounds.

3. Increases in food intake and decreases in resting energy expenditure are largely responsible for postcessation weight gain.

Chapter 11: Psychological and Behavioral Consequences and Correlates of Smoking Cessation

1. Short-term consequences of smoking cessation include anxiety, irritability, frustration, anger, difficulty concentrating, increased appetite, and urges to smoke. With the possible exception of urges to smoke and increased appetite, these effects soon disappear.

2. Smokers who abstain from smoking show short-term impairment of performance on a variety of simple attention tasks, which improves with nicotine administration. Memory, learning, and the performance of more complex tasks have not been clearly shown to be impaired. Whether the self-reported improvement in attention tasks upon nicotine administration is due entirely to relief of withdrawal effects or is also due in part to enhancement of performance above the norm is unclear.

3. In comparison with current smokers, former smokers have a greater perceived ability to achieve and maintain smoking abstinence (self-efficacy) and a greater perceived control over personal circumstances (locus of control).

4. Former smokers, compared with current smokers, practice more health-promoting and disease-preventing behaviors.

Volume Appendix: National Trends in Smoking Cessation

1. By 1987, more than 38 million Americans had quit smoking cigarettes, nearly half of all living adults who ever smoked.

2. The percentage of ever cigarette smokers who are former cigarette smokers (quit ratio) has increased from 29.6 percent in 1965 to 44.8 percent in 1987 at an average rate of 0.68 percentage points per year. The quit ratio has increased among men and women, among blacks and whites, and among all age and education subgroups. Between 1966 and 1987, the rate of increase in the quit ratio among college graduates was twice the rate among high school dropouts.

3. About one-third of all former cigarette smokers who have maintained abstinence for at least 1 year may eventually relapse. As the duration of abstinence increases, relapse becomes less likely.

4. Quitting activity, as measured by the proportion of people smoking at 12 months before a survey who quit for at least 1 day during those 12 months, has increased slightly over time. Between 1978 and 1987, this proportion increased from 27.8 to 31.6 percent.

5. Female smokers were more likely than male smokers to have quit smoking cigarettes for at least 1 day during the previous year; however, there were no gender differences in the proportion abstinent for 1 to 4 years. Men were more likely than women to have been abstinent for 5 years or more. These findings do not take into account the use of tobacco products other than cigarettes.

6. Black smokers were more likely than white smokers to have quit for at least 1 day during the previous year. Blacks, however, were less likely than whites to have been abstinent for 1 year or more.

7. Younger smokers (aged 20 to 44) were more likely than older smokers to have quit for at least 1 day during the previous year.

8. Smokers with less education tend to be less likely to have quit for at least 1 day during the previous year compared with those having more education. In addition, those with lower levels of education are less likely to have been abstinent for 1 year or more.

9. In 1964, about three-fourths of all current smokers predicted that they would "definitely" or "probably" be smoking in 5 years. In 1986, fewer than half of all current smokers felt the same way. Moreover, while more than 20 percent of current smokers in 1964 predicted that they would "definitely" be smoking in 5 years, only about 7 percent of current smokers in 1986 so predicted.

10. Current smokers in 1987 were more than three times as likely as current smokers in 1964 to report having received advice from a doctor to stop smoking.

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GLOSSARY

AARP	American Association of Retired Persons
ACS	American Cancer Society
AR	attributable risk
AUTS	Adult Use of Tobacco Survey
BM	bone mass
BMI	body mass index
BP	blood pressure
BPS	Baseline Prevalence Survey
BRFSS	Behavioral Risk Factor Surveillance System
BUPA	British United Providence Association
CASS	Coronary Artery Surgery Study
CC	closing capacity
CCDPHP	Center for Chronic Disease Prevention and Health Promotion
CDC	Centers for Disease Control
CHD	coronary heart disease
CI	confidence interval
cig	cigarettes
CNS	central nervous system
CO	carbon monoxide
COHb	carboxyhemoglobin
COPD	chronic obstructive pulmonary disease
CPS	Center for Preventive Services
CPS-I	Cancer Prevention Study I
CPS-II	Cancer Prevention Study II
CV	closing volume
CVD	cardiovascular disease
DBP	diastolic blood pressure
DHEW	Department of Health, Education, and Welfare
DHHS	Department of Health and Human Services
$D_{LCO}SB$	carbon monoxide diffusing capacity
DPA	dual photon absorptiometry
DSM-III-R	*Diagnostic and Statistical Manual of Mental Disorders*
FEV_1	1-sec forced expiratory volume
FVC_1	1-sec forced vital capacity
HANES	Health and Nutrition Examination Survey

HB_SAg	hepatitis B surface antigen
HCN	hydrogen cyanide
HDL-C	high-density lipoprotein cholesterol
HMO	health maintenance organization
HR	heart rate
IARC	International Agency for Research on Cancer
LDL-C	low-density lipoprotein cholesterol
MI	myocardial infarction
MMEF	mid-maximum expiratory flow
MRC	Medical Research Council
MRFIT	Multiple Risk Factor Intervention Trial
NCHS	National Center for Health Statistics
NCI	National Cancer Institute
NHANES-I	National Health and Nutrition Examination Survey I
NHEFS	NHANES Epidemiologic Followup Study
NHIS	National Health Interview Survey
NHLBI	National Heart, Lung, and Blood Institute
NNS	National Natality Survey
OSH	Office on Smoking and Health
PBI	penile brachial index
PCA	percent cortical area
pDL	predicted diffusing capacity
PEF	peak expiratory flow
PHS	Public Health Service
POMS	Profile of Mood States
PPA	phenylpropanolamine
ppd	packs per day
PSA	public service announcement
REE	resting energy expenditure
RR	relative risk
SBP	systolic blood pressure
SCN^-	thiocyanate
SD	standard deviation
SES	socioeconomic status
SGA	small gestational age
SIDS	sudden infant death syndrome
SPA	single photon absorptiometry
ST	smokeless tobacco
STD	sexually transmitted disease
TLC	total lung capacity
TQ	Fagerstrom Tolerance Scale
VC	vital capacity
WHO	World Health Organization
WHR	ratio of waist to hip circumference

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